Informational Leaflet 153

THE DEVELOPMENT OF THE ALASKAN FISHERY FOR TANNER CRAB, Chionoecetes species, WITH PARTICULAR REFERENCE TO THE KODIAK AREA, 1967-1970.

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THE DEVELOPMENT OF THE ALASKAN FISHERY FOR TANNER CRAB, Chionoecetes species, WITH PARTICULAR REFERENCE TO THE KODIAK AREA, 1967-1970

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INTRODUCTION

A United States' fishery has recently developed in Alaska for the tanner crab, Chionoecetes sp., beginning in 1968 as a supplemental fishery during closed king crab seasons and continuing in that status through 1970. The Kodiak area, where most of the study took place, continues as the highest producing tanner crab area, and in many respects is typical of development of the fishery elsewhere in Alaskan waters. Despite poor market conditions, U.S. landings continue to increase with 14.5 million pounds landed during 1970. This report discusses two aspects of the new fishery as follows:

I. Development of the fishery in Alaska.

II. Catch-per-unit-effort and size frequency data in the Kodiak area.

Chionoecetes bairdi probably comprises over 95 percent of the Alaskan tanner crab catch. Males landed by the fishery rarely exceed 190 mm in carapace width[1/]. Regulations prohibit the taking of females which rarely exceed 120 mm carapace width. The largest male and female tanner crab captured in the Kodiak area measured 207 and 127 mm respectively. C. bairdi has a geographical range from Puget Sound, Washington (Slipp, 1952) to the Bering Sea. West of the Aleutian Islands, the range extends toward that of its "Western Pacific cognate, C. opilio elongatus" (Garth, 1958). The depth range is from shoal water to 259 fathoms (Table 1). In Alaska, C. bairdi is the only tanner crab fished commercially south or east of the Aleutian Islands.

1/ Measured to the nearest millimeter at greatest width, excluding spines, using vernier calipers.

Table 1. Tanner crabs occurring in Alaska (Source: Garth, 1958).

Species	Depth range in Alaska	Geographical range in Alaska
Chionoecetes bairdi Rathbun	Shoal water to 259 fathoms	Pacific Ocean and Bering Sea
Chionoecetes opilio (O. Fabricius)	7-85 fathoms	Bering Sea and Arctic Ocean
Chionoecetes angulatus Rathbun	49-1625 fathoms	Pacific Ocean and Bering Sea

In addition to C. bairdi, the commercial catch from the Bering Sea includes a small proportion of C. opilio (Kingsbury, unpublished report), a smaller closely related species. While C. bairdi and C. opilio are reported to retain distinct populations (Takeshita et al, 1969), hybridism is also reported common between them (John Karinen, personal communication). Large fisheries are established in the waters of Japan and eastern Canada for the widely distributed C. opilio with Japan landing over 45 million pounds in 1964, and Canada about 18 million pounds in 1969 (Watson, 1969, 1970). Russia and South Korea also have domestic Chionoecetes crab fisheries. A decline in Chionoecetes landings in the Sea of Japan has occurred since 1966 (Sinoda, 1968), and Japan has since established a large Chionoecetes fishery off Alaska (Zahn, 1970).

Because life histories of C. bairdi and C. opilio are similar, research methods developed in eastern Canada and Japan are being applied to the fishery biology of C. bairdi in Alaska.

A third species of commercial size, Chionoecetes angulatus, unreported in the commercial catch, inhabits the abyssal plains of the Gulf of Alaska and Bering Sea, having been trawled in Alaska from depths down to 1,625 fathoms (Garth, 1958).

Little research has been published to date on C. bairdi. Bright's (1967) Cook Inlet king crab dissertation included tanner crab captivity growth data, trawling data, and a brief life history synopsis. Eastern Bering Sea preliminary exploratory fishing data were presented by Karinen at the second Alaska Shellfish Conference (Haynes and Lehman, 1969). McMullen and Yoshihara (1970) reported on the status of the tanner crab fishery in the Peninsula-Aleutians area and Brown and Powell (in press) discussed male size at maturity and a few aspects of reproduction in the Kodiak area.

METHODS

Information on the growth of the fishery was obtained from sources cited herein.

Catch-per-unit-effort data was obtained with the use of logbooks of the type already in use for Kodiak king crab research. Most fishermen were thus already familiar with the logbooks. Logs were picked up periodically during off-loading of crabs. Captains were interviewed to complete and clarify log information. The program was conducted only during the closed king crab season so that catch-per-unit-effort data derived was confined to those vessels fishing exclusively for tanner crabs. The 1969 data were collected from March through July and the 1970 data from mid-January through April. Crab weights were estimated by calculating processor landing weights against numbers of crabs logged per landing. The percentage of the catch logged was estimated from fish tickets by calculating weights of logged landings against total area catches in pounds for each month.

Incidence of shell disease was monitored in conjunction with width frequency sampling from the Kodiak area and Shumagin Islands in 1970. An infected crab was one on which black nodules were immediately apparent.

Size frequency sampling was conducted during the off-loading of commercial vessels at Kodiak. A sample from a given landing was comprised of 50 or more crabs obtained at dockside randomly from one or more off-loading buckets. Carapace widths were used rather than lengths with the measurement consisting of the widest carapace dimension, excluding lateral spines as much as practicable. Carapace width means were weighted according to the number of crabs in the delivery. Sampling was conducted during the closed king crab season only. The 1969 data is from February through July while that for 1970 is from January through April.

RESULTS

Fishery Growth and Development in Alaska

The tanner crab catch in Alaska increased markedly from less than 0.2 million pounds landed during 1967 (Nelson, 1969) to 11.2 million pounds landed during 1969 (Figure 1). Poor market conditions held the 1970 landings to 14.5 million pounds (Alaska Department of Fish and Game, 1970). The marked increase was directly related to a decline of king crab catches in Alaskan waters. As king crab landings declined after 1967, the recently-expanded industry for the first

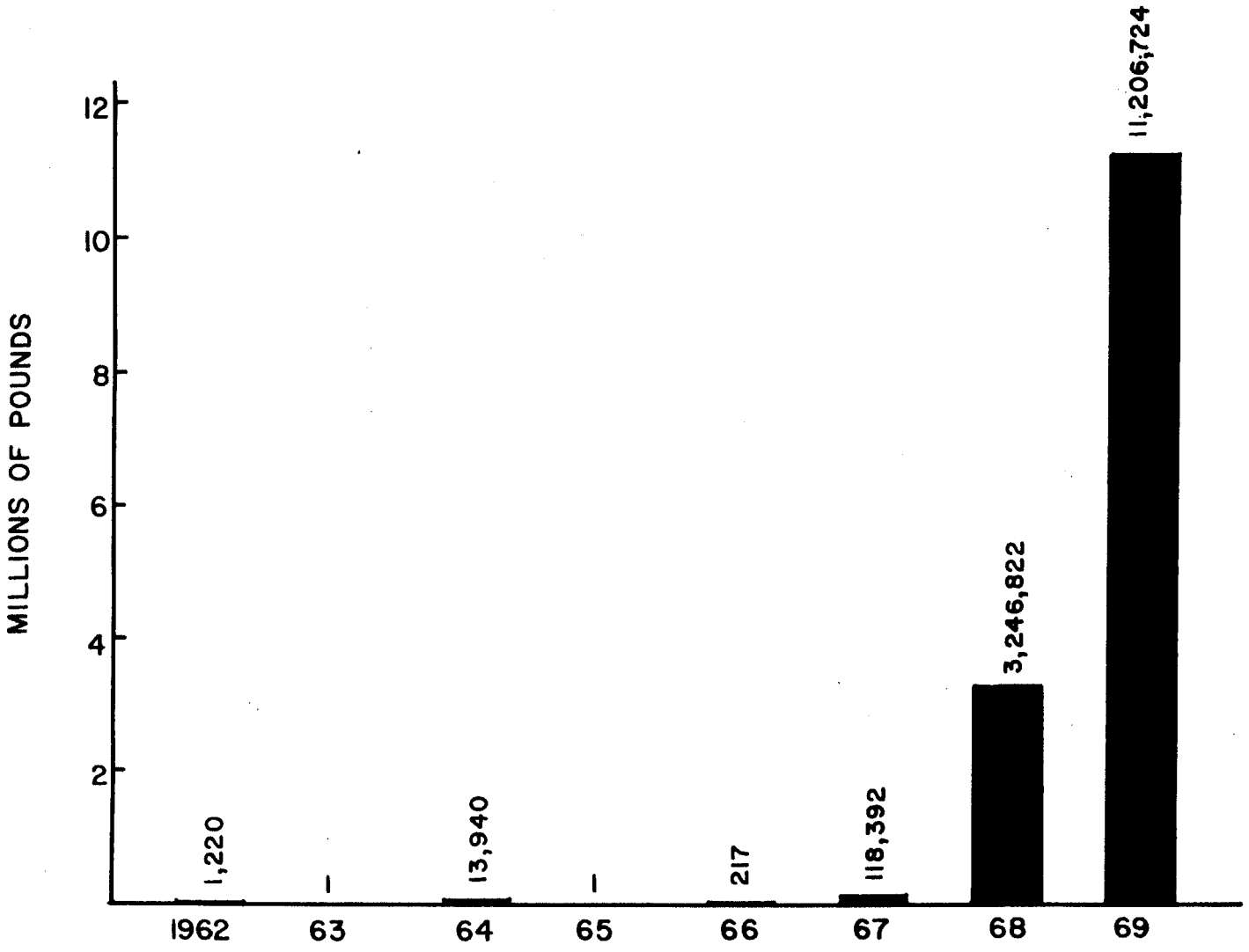

Figure 1. Tanner crab catch landed in Alaska, 1962-1969.

time applied effort specifically to the tanner crab fishery (Figure 2). The only closed tanner crab season in the Kodiak area occurs for two weeks just prior to the opening of king crab season. In the Pacific Ocean where the bulk of the catch occurs, landings are low during the open king crab season in the latter half of the year. Landings are highest from February through May, declining when Dungeness crab and other fisheries commence in the spring (Figure 3). The relation between the two fisheries is somewhat different in the Bering Sea because there is no closed king crab season.

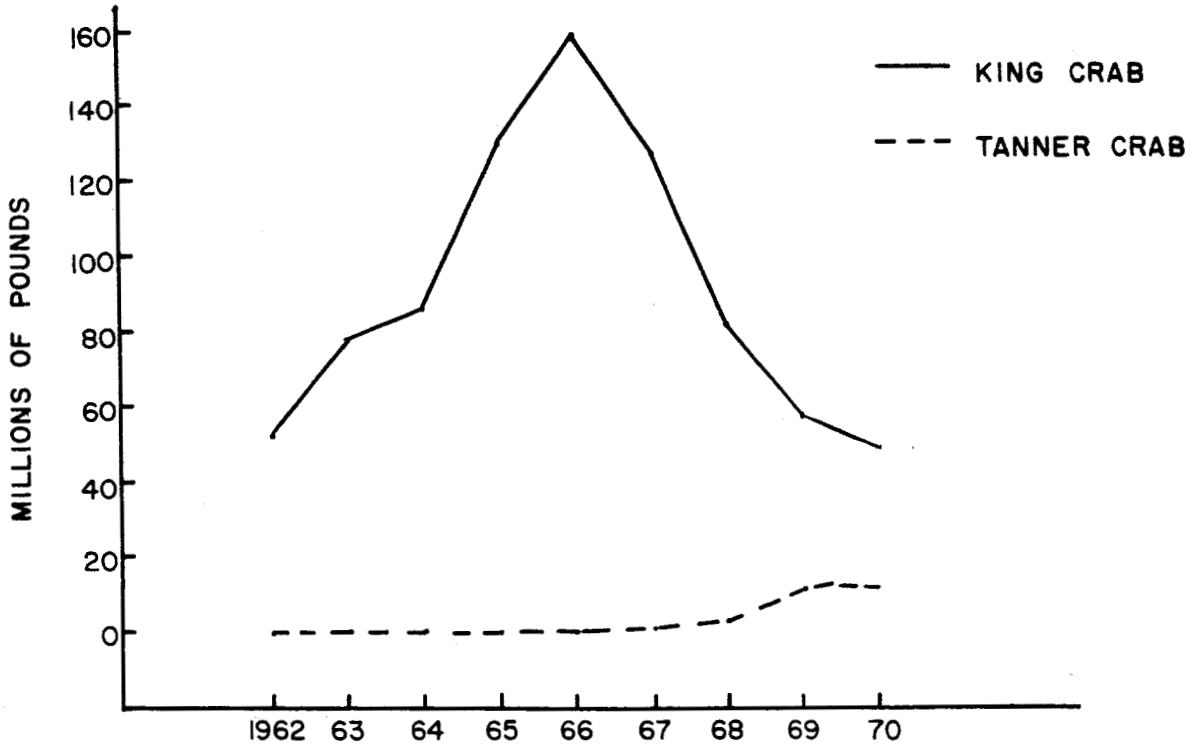

Figure 2. Relation between Alaskan annual tanner and king crab catches, all areas, 1962-1970.

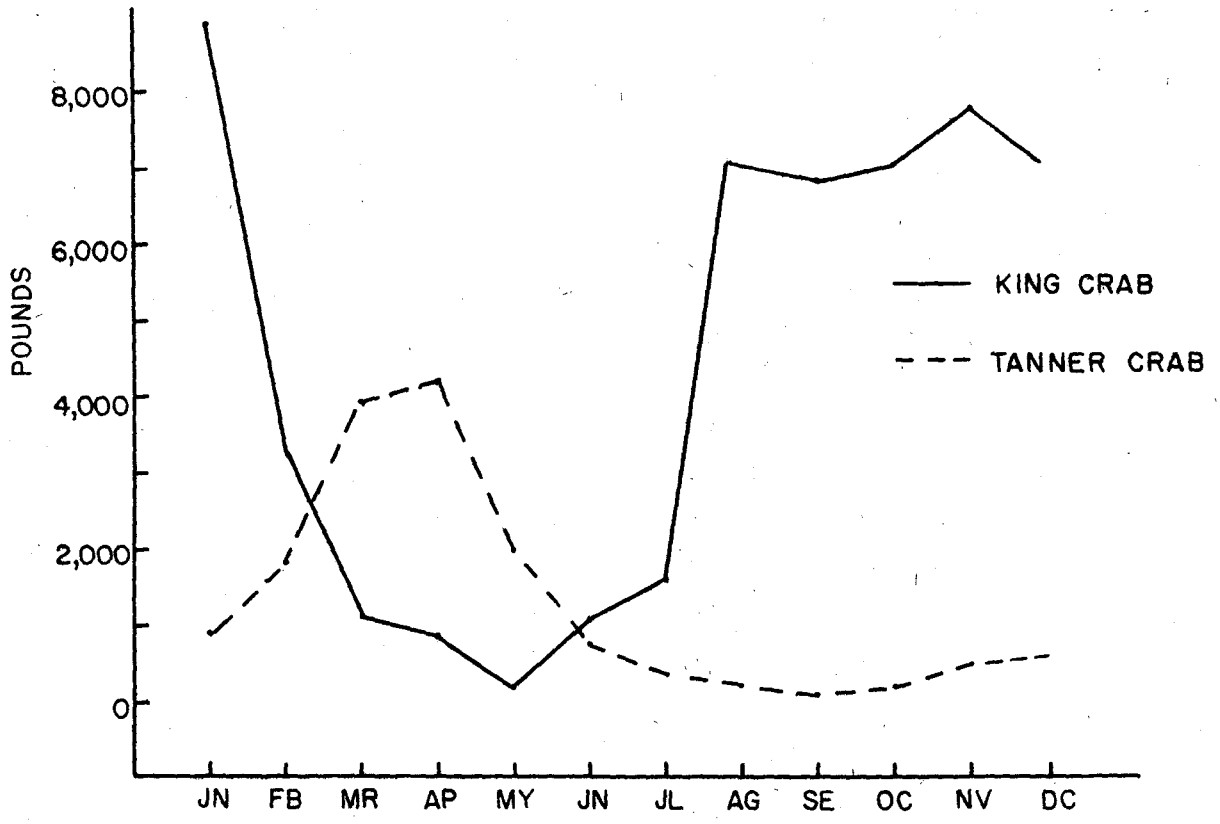

Figure 3. Relation between Alaskan monthly tanner and king crab catches, all areas, 1970. (Source: Alaska Department of Fish and Game, 1970.)

The Kodiak area continues to lead in production, landing 61 percent of the catch in 1969 (Figure 4). Greater relative increases, however, have been shown in other areas during 1969 and 1970, particularly in the Cook Inlet, Prince William Sound and Bering Sea areas. The tanner crab catch during 1967-69 in the Kodiak area is illustrated in Figure 5. Production was greatest on the eastside in 1969, accounting for 43 percent of the Kodiak area catch. Significant production also occurred in Marmot-Chiniak Bays and the westside.

Tanner crab fishing gear consists predominantly of modified king crab pots (Figure 6). Regulations require that tunnel entrances in tanner crab pots be no greater than 4 inches in height after the close of king crab season. Most fishermen also reduce the mesh size of pots in order to retain the smaller tanner crab. The pot is selective for tanner crabs and is achieving success. Various mesh sizes are used with 6 inch mesh (stretched measure) and laced (bisected) king crab mesh common. A new top entry pot developed specifically for tanner crab is also achieving success (Figure 6).

Poor market conditions continue to be the greatest deterrent to the growth of the fishery, and result from the following processing and marketing conditions:

1. Uneconomical extraction of meat from the shell.

2. Relatively low consumer acceptance.

3. Competition on the U.S. market from imported Chionoecetes crab meat.

4. A black encrustment on crab shells (shell syndrome).

Extraction of meat from tanner crab legs using equipment and methods designed for the larger king crab requires a high amount of labor per yield. Shell fragments in "shoulder meat" require considerable hand labor for removal.

Curtailment of landings in May 1970 (Figure 3) reflected poor market conditions resulting largely from Japanese and eastern Canadian Chionoecetes imports. Japan and Russia had successful tanner crab fisheries in the eastern Bering Sea by 1967 (Pereyra, 1967). Japanese and Russian crab fleets continue to operate successfully (Figure 7), taking 17.6 million and 6.2 million tanner crabs in 1969 respectively from waters of the Alaska Continental Shelf (U.S. Bur. Comm. Fish., 1970). The total U.S. Alaskan catch was 3.8 million crabs in the same period, or approximately one-sixth that of the combined foreign fleet. C. opilio (queen crab) produced in Canadian-Atlantic waters competes with

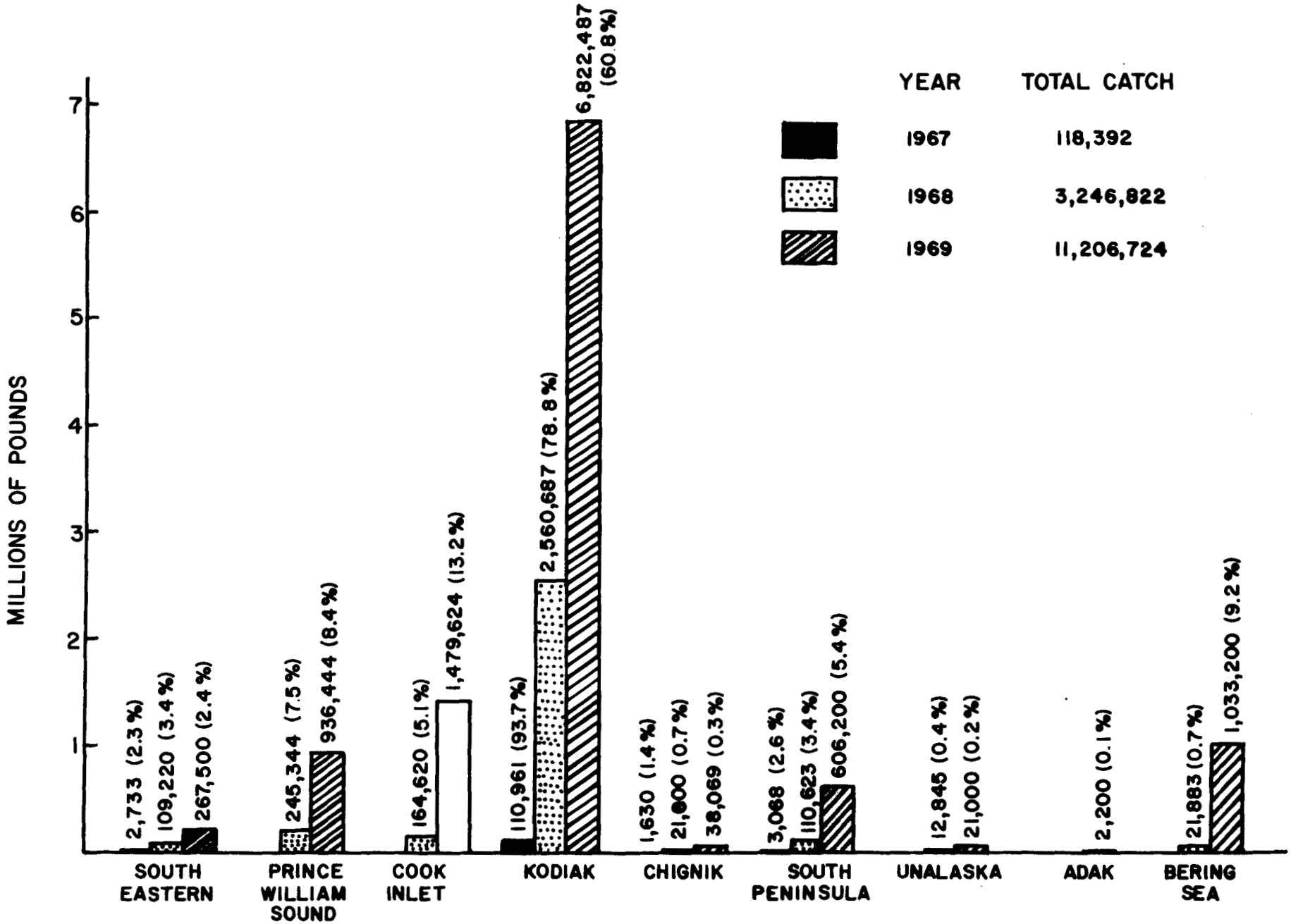

Figure 4. Tanner crab landed in Alaska, by area, 1967-1969. Pounds and percentages of total annual catch shown for each column.

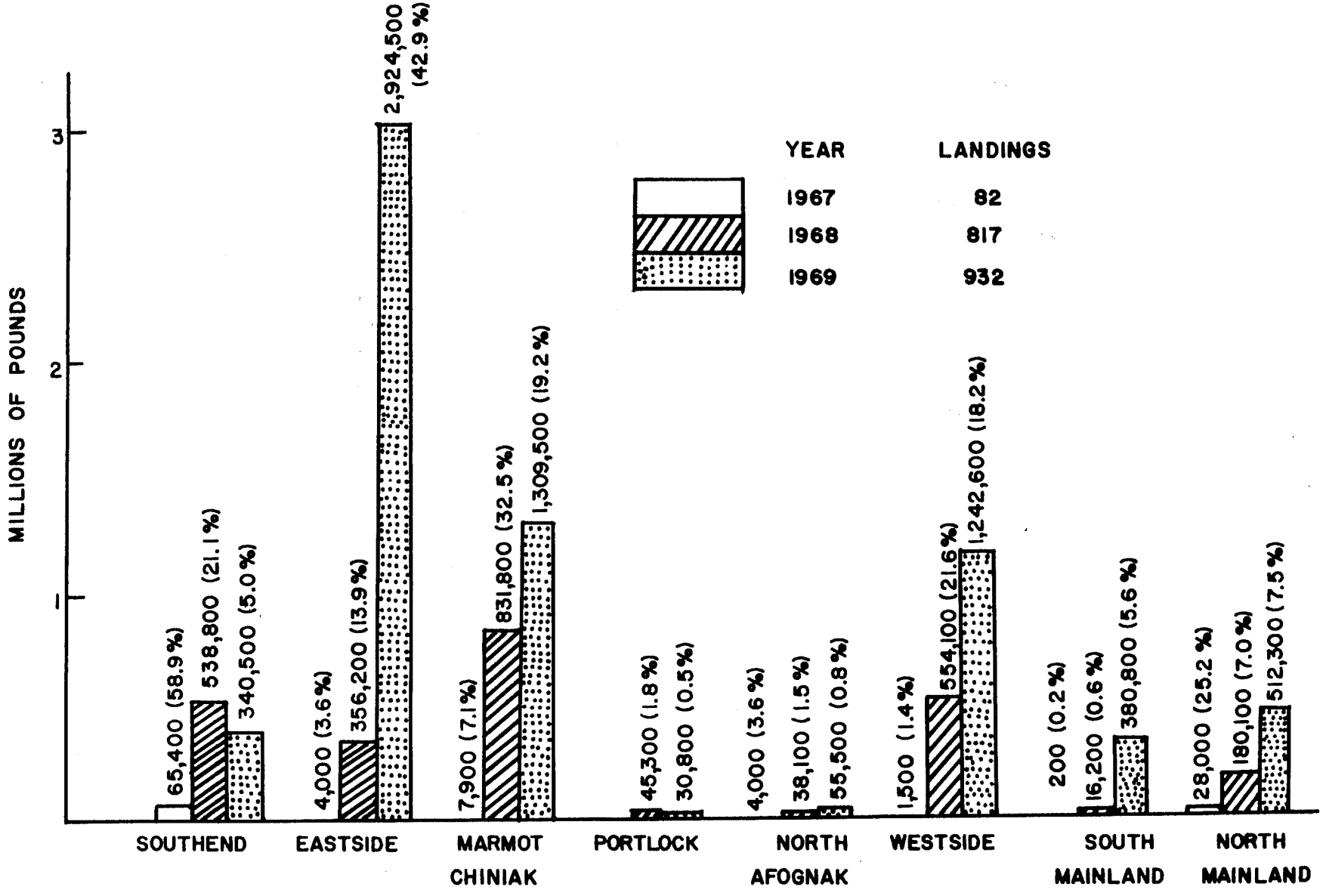

Figure 5. Kodiak area tanner crab catch by geographical area, 1967-1969. Pounds and percentages of total annual catch shown for each column. (Source: Alaska Department of Fish and Game, unpublished report).

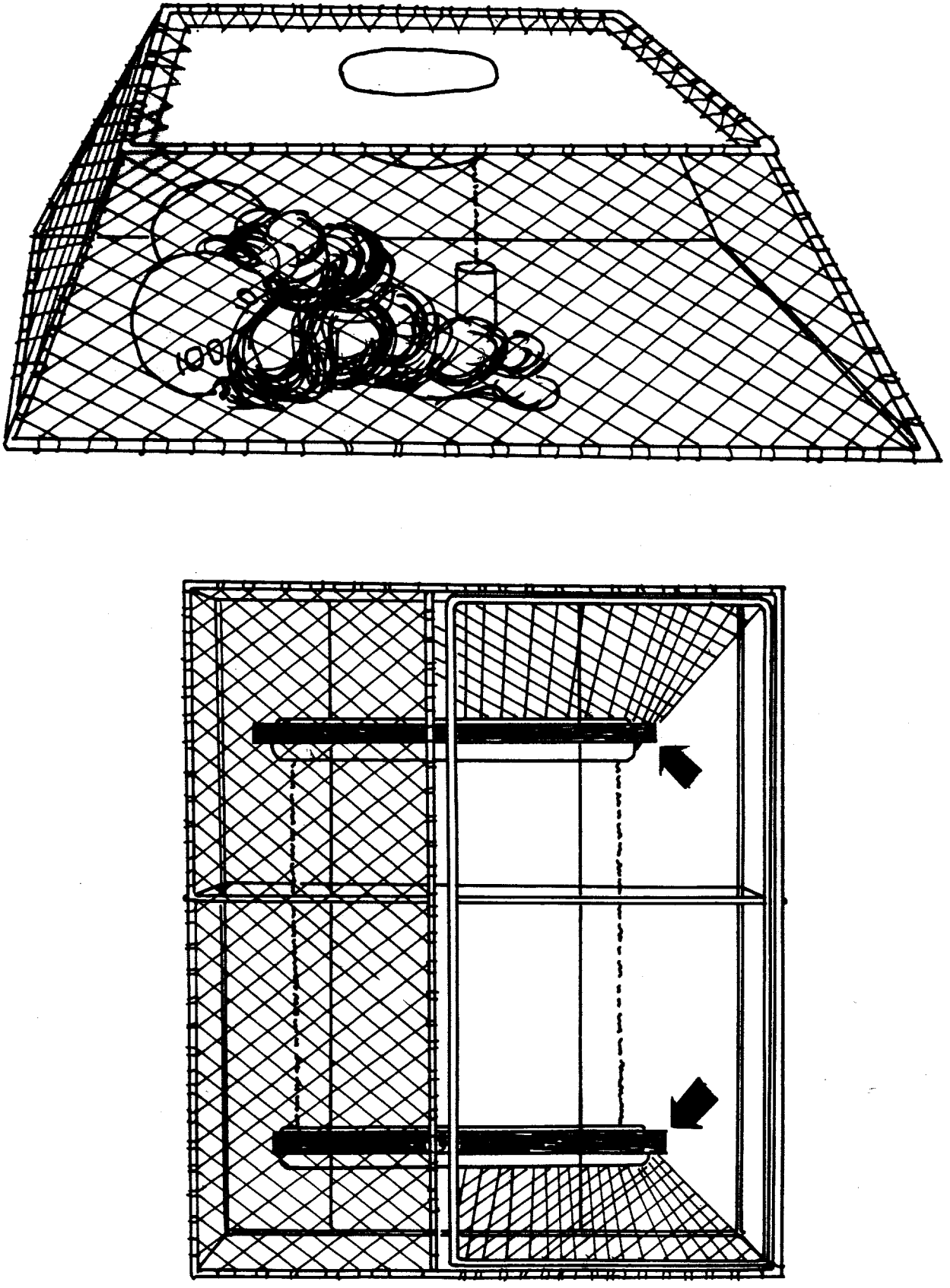

Figure 6. New top entry tanner crab pot with hinged base (above). King crab pot converted for tanner crab fishing (below, arrows indicate tunnel reduction slats).

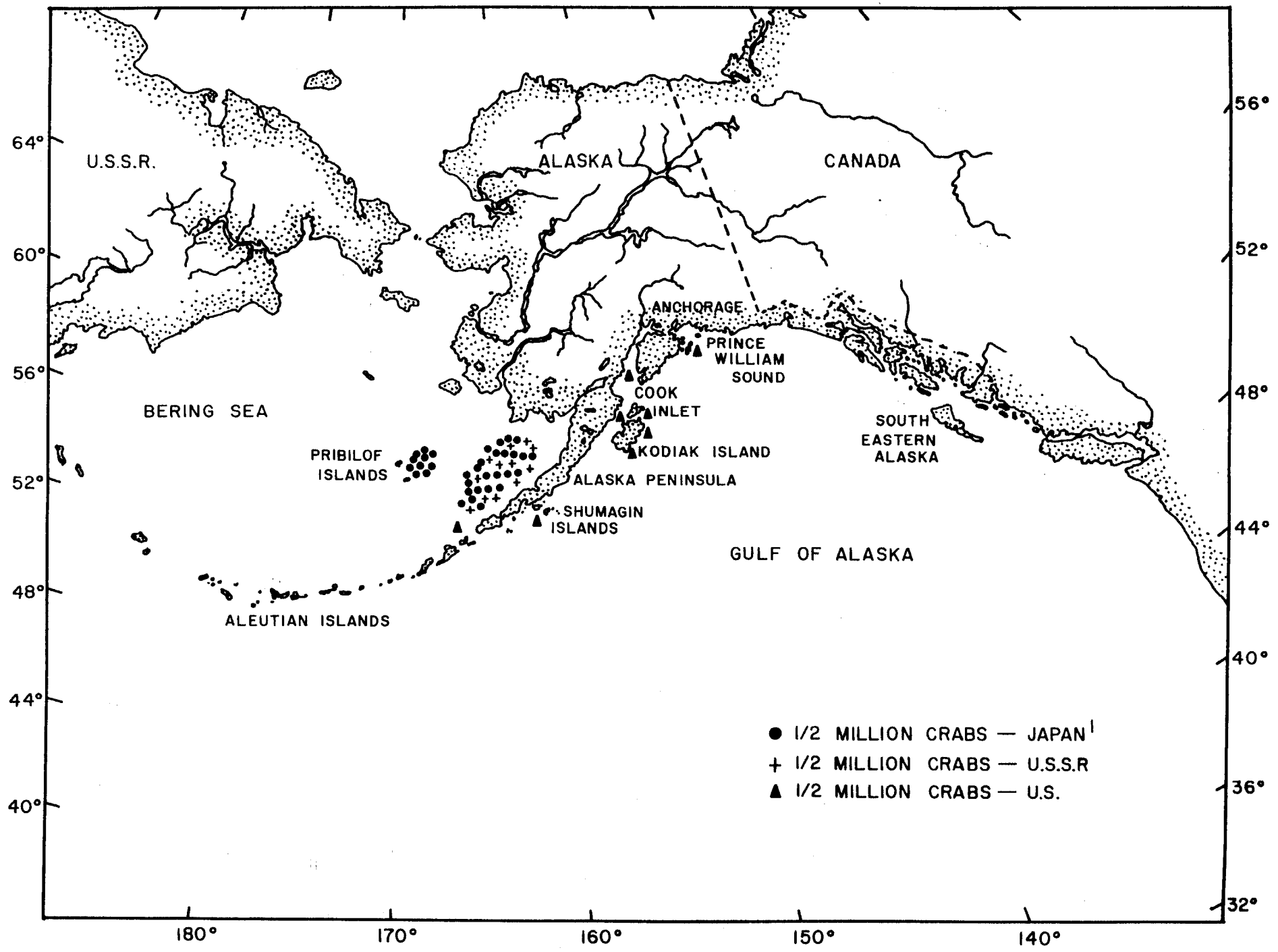

Figure 7. Map comparing the approximate tanner crab catches reported by Japan, the U.S.S.R. and U.S. from the Alaska Continental Shelf in 1969.

Alaskan tanner crab on the U.S. market. The Canadian fishery, which began in 1966, had landings of 18 million pounds during 1969 (Watson, 1970).

Shell syndrome of Alaskan tanner crab is under study and may result from one or more chitonoverous organisms similar to those described by Rosen (1970). Black encrusting nodules are produced on shells. No effect on the meat of the crab has been noted but processors refuse to accept heavily affected crabs because of difficulty in keeping the nodules off cannery meat belts.

One thousand crabs were sampled in approximate proportion to total landings from four locations in the Kodiak and Shumagin Islands. Most affected shells had only early stages of the syndrome. Incidence was highest from the Kodiak Eastside sub-area which had 75 percent affected crabs during February through April, 1970 (Figure 8). Thirty-seven percent of the shells of all crabs sampled were affected (Figure 9).

Logbook and Size Frequency Data, Kodiak Area

Nine tanner crab catch areas have been established based on distribution of fishing effort and the statistical area system (Figure 10). An extensive logbook program was conducted in 1969 and approximately one-half of all pot hauls from the three major sub-areas were logged (Table 2). The Eastside, Marmot-Chiniak and Westside sub-areas were analyzed in terms of catch-per-effort. Data from the other six sub-areas were insufficient for analysis because of low fishing effort. The Westside averaged 95 crabs per pot from March through July, by far the highest of the three sub-areas. The crabs from that area were also the lightest in weight, averaging 2.6 pounds per crab. The Marmot-Chiniak and Eastside sub-areas were similar to each other in terms of crabs per pot (approximately 55) and weight per crab (2.8 pounds). The highest number of crabs per pot in all three areas occurred during April. The lowest catches and CPUE occurred during June and July in the two sub-areas researched. Kodiak area landings were low during the January-February period of 1969 (Table 3) because many fishermen had not yet converted their pots for tanner crab fishing. Effort increased in March and the logbook program began, continuing through July (Table 4). A majority of the pot lifts logged during 1969 were from the March-April period.

The catch per pot during March-April 1970 showed no decrease from that in March-April 1969. Specific effort for tanner crabs began immediately after the close of the king crab season in mid-January, and the logbook program began then also. Fewer pot lifts were recorded during March-April 1970 than during the same period in 1969. Landings dropped markedly in May, 1970, which led to termination of the program for the year.

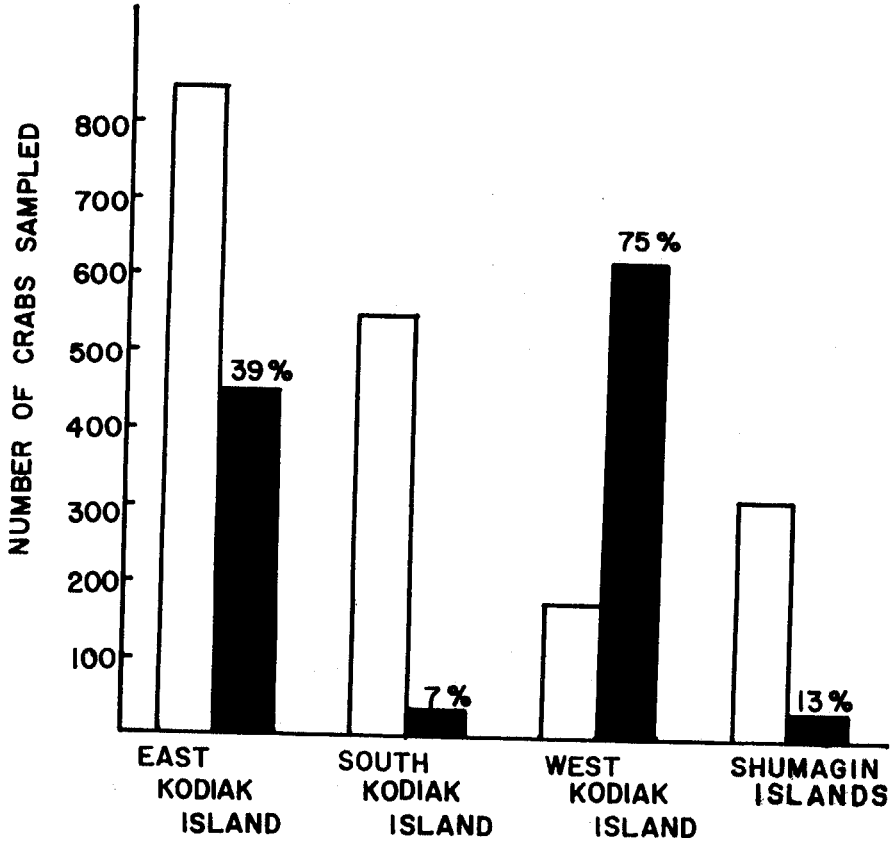

Figure 8. Occurrence of tanner crab shell syndrome in four geographical areas of Alaska, February-April, 1970. Percentage of incidence shown for each area.

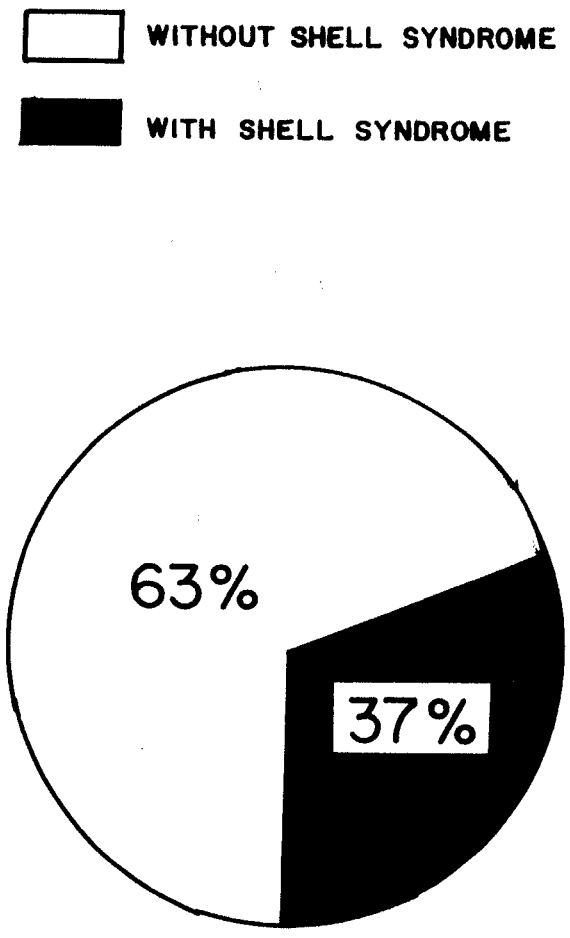

Figure 9. Proportion of shell syndrome for total tanner crab sampled in the Kodiak area and Shumagin Islands, Alaska, February-April, 1970.

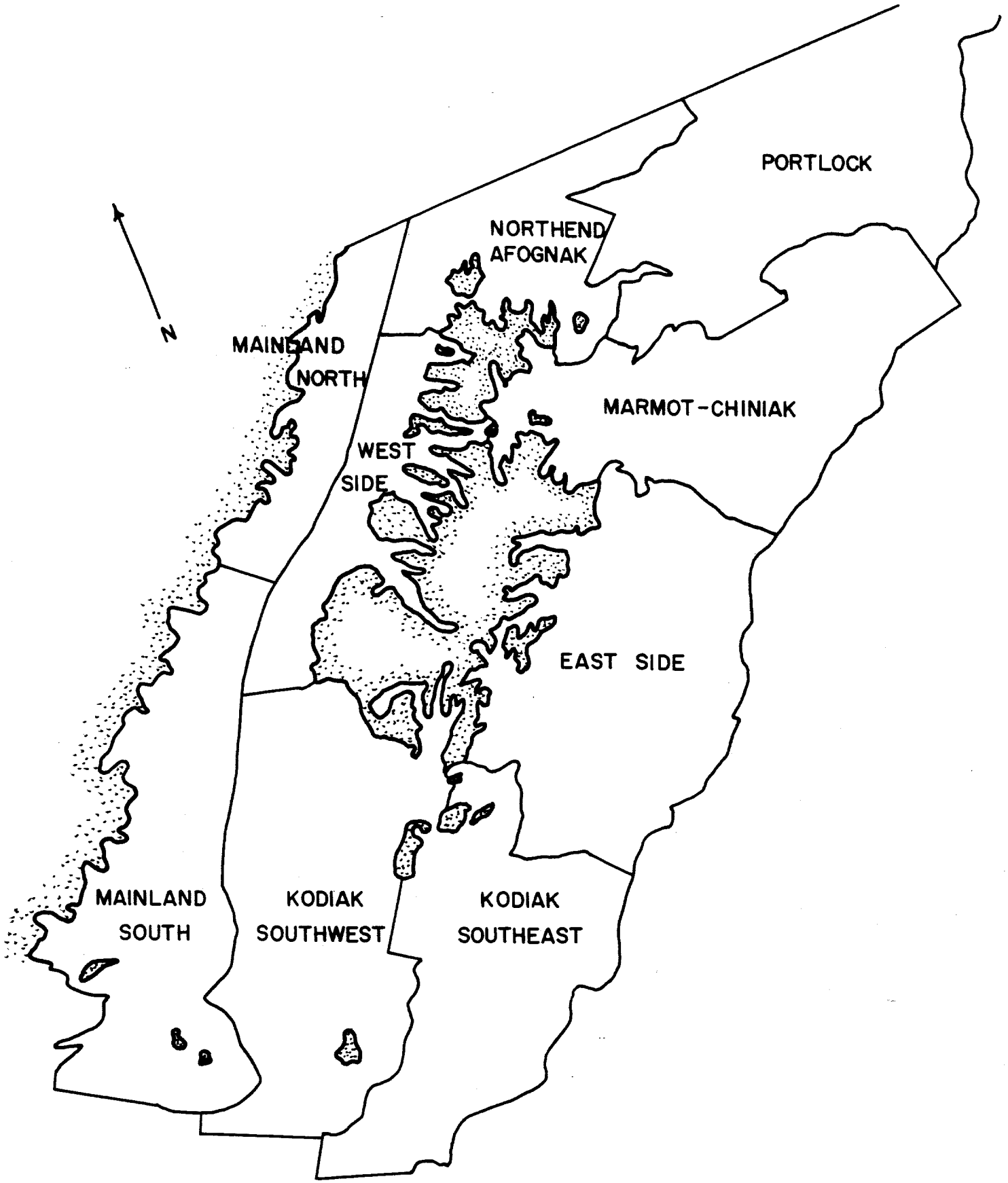

Figure 10. Tanner crab sub-areas within the Kodiak Management Area (after Kingsbury).

Table 2. Fishery statistics for tanner crabs logged from the Eastside, Marmot-Chiniak and Westside sub-areas of Kodiak Area, Alaska, 1969 (Source: Kingsbury, unpublished report).

Period	No. pot hauls logged	Percent of catch logged (lbs.)	Crabs per pot	Pounds per crab
EASTSIDE				
March	1,671	42	54	2.7
April	2,667	41	63	2.9
May	389	9	43	2.7
Average		34	58	2.8
MARMOT-CHINIAK				
March	589	27	55	2.8
April	1,067	90	60	2.9
May	866	53	50	3.0
June	494	44	45	2.7
July	1,084	63	46	2.7
Average		53	52	2.8
WESTSIDE				
March	239	45	90	2.7
April	1,103	78	120	2.5
May	618	46	98	2.7
June	563	70	80	2.6
July	576	72	58	2.5
Average		63	95	2.6

Table 3. Monthly tanner crab catches in pounds landed from the Kodiak Area, 1967-1970.

Month	1967	1968	1969	1970
January	*	59,447	182,054	705,490
February	*	103,233	172,459	1,208,112
March	9,891	131,514	1,182,569	2,726,522
April	*	348,175	2,177,392	1,700,150
May	20,312	653,672	1,385,753	760,464
June	*	393,052	589,765	183,724
July	*	309,443	504,665	144,156
August	*	120,357	50,329	*
September	6,567	102,401	48,565	9,460
October	9,853	162,275	304,840	14,765
November	32,766	86,108	78,636	117,650
December	31,572	91,010	145,460	135,344
Annual Totals	110,961	2,560,687	6,822,487	7,749,859

* No catch reported

Table 4. Comparison between 1969 and 1970 tanner crab logbook programs, Kodiak Area, Alaska.

	Vessels with logs		Pot hauls logged		Crabs per pot	
Period	1969	1970	1969	1970	1969	1970
Jan-Feb.	-	11	-	2,632	-	58
Mar-Apr.	16	9	7,695	2,473	69	71
May-July	10	-	5,098	-	58	-

The number of crabs per pot retained by fishermen was 59 during the January-February, 1970 period. The catch was highest during the March-April period for both 1969 and 1970. During this, the only comparative period for the two years, the catch per pot was 69 and 71 per pot respectively. The catch averaged 59 per pot during the May-July 1969 period.

Average numbers of crabs per pot increased with length of soak (Figure 11). The catch was 55 crabs per pot for both years on a soak of up to 24 hours. The catch increased to a maximum of 78 per pot on a soak time of 4 days or more. The numbers per pot varied little for similar soak times compared between the 1969 and 1970 periods.

The catch per pot haul was between 50 and 70 per pot at depths of less than 100 fathoms. The highest catch per pot came from depths of 100-120 fathoms where it averaged 97. The 1969 data show a slight decrease in the catch per pot at depths greater than 120 fathoms. In 1970 there was insufficient data for analysis for depths greater than 120 fathoms (Figure 12).

Size frequency sampling was conducted during portions of 2 years only. Size frequency data obtained during February through July, 1969 indicate that crabs landed from the Eastside sub-area averaged 158.7 mm, from the Marmot-Chiniak 157.6 mm, and from the Westside 152.2 mm in carapace width (Table 5). During January through April, 1970 the mean carapace widths of crabs landed from these three sub-areas showed only slight decreases from 1969.

DISCUSSIONS AND CONCLUSIONS

Growth and Development of the Fishery

Conversion of king crab pots for tanner crab was initially accomplished by sewing and retaining additional meshes in webbing (lacing). The resultant smaller mesh however caused excessive juvenile king crabs to be retained and handled, resulting in a regulation requiring a mesh size of 9 inches stretched measure (s.m.) or greater to be placed on at least 25 percent of the vertical area of each king crab pot during the king crab season. In order to retain more tanner crabs, fishermen convert back to a mesh of 6-1/2 inches (s.m.) or smaller by February when the king crab season closes in most areas. In August, the opening month for king crab in most areas, fishermen must again comply with the 9-inch mesh regulation. Regulations allow fishermen a means of converting one side only of each pot alternately for king and tanner crab. On the remainder of the pot, tanner crab mesh is retained throughout the year.

Regulations also include tanner crab pot specifications intended for the protection of king crab. During closed king crab season, legal tanner crab pots

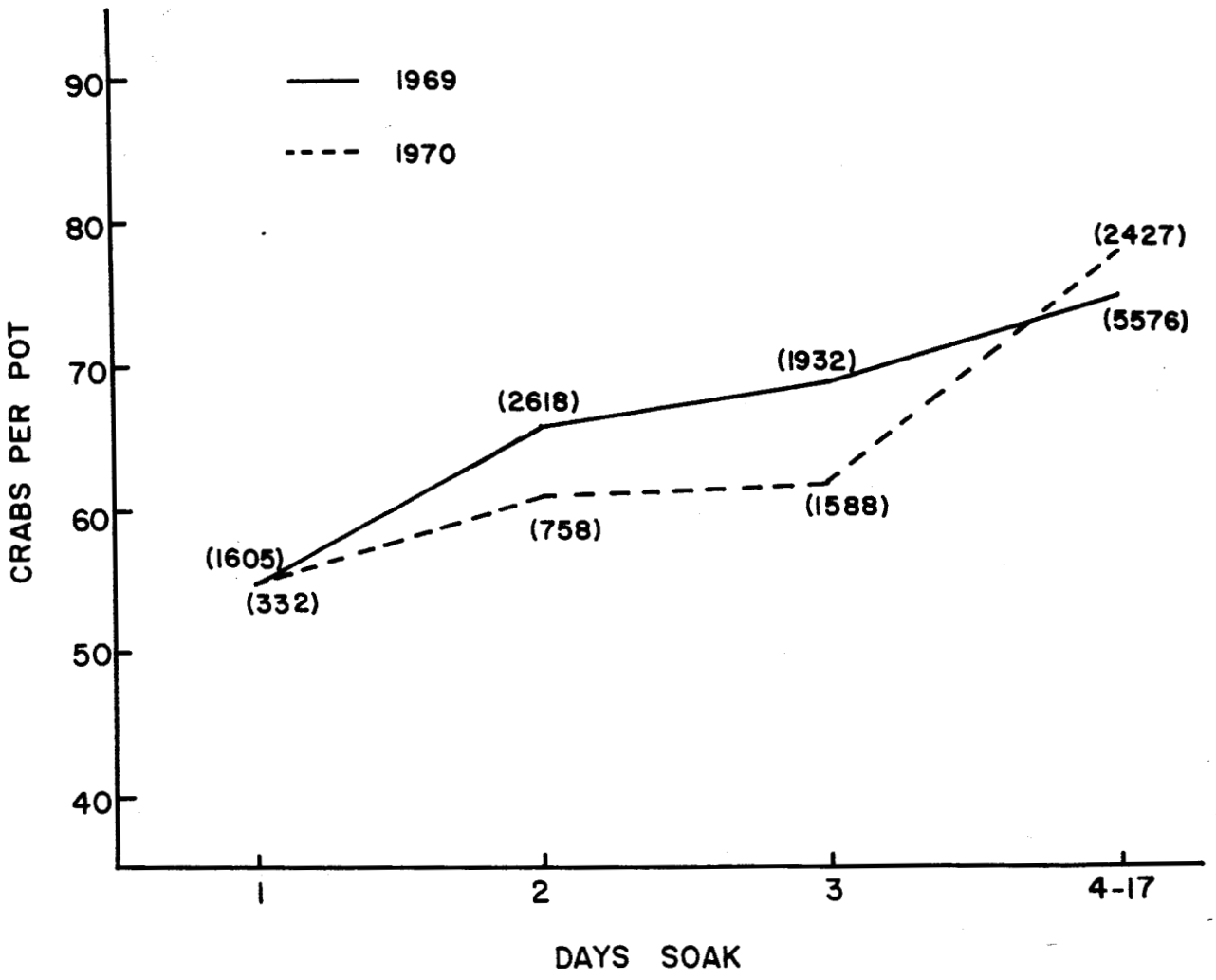

Figure 11. Relation between number of tanner crabs per pot haul and soak time, compared between 1969 (March-July) and 1970 (January-April).

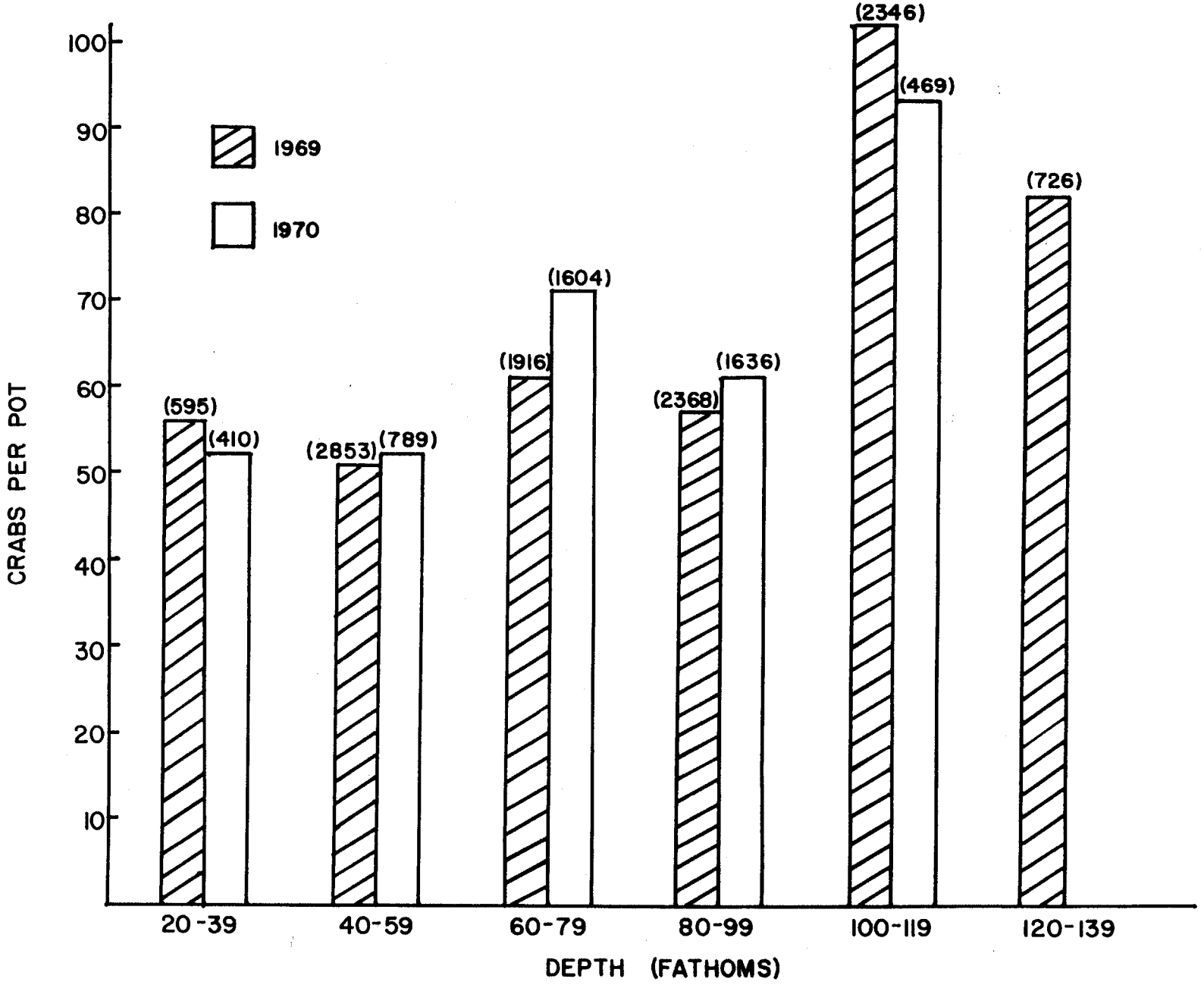

Figure 12. Relation between number of tanner crabs per pot haul and depth compared between 1969 (March-July) and 1970 (January-April).

Table 5. Comparison of mean widths of tanner crabs sampled from commercial landings of three Kodiak sub-areas, February-July, 1969 and January-April, 1970.

Sub-area	Number of landings sampled		Mean carapace width	
	1969	1970	1969	1970
Eastside	15	15	158.7	157.9
Marmot-Chiniak	17	10	157.6	155.7
Westside	18	10	152.2	151.7

must have tunnel openings which are either 4 inches or less in height (converted king crab pots) or round top entry tunnel openings. The intent of the regulation is to reduce handling of large king crabs by barring their admission into the pots. Since few top entry pots are in operation, most fishermen must alter tunnel entrances on king crab pots at the close of king crab season. Conversion is accomplished by wiring wooden slats onto tunnel entrances (Figure 6) which are removed at the opening of king crab season. Crab pots range in size from approximately 6' x 6' through 8' x 8' with 6' x 6' pots considered to be adequate in size by most king and tanner crab fishermen.

The newly-developed top entry pot has a round fiberglass tunnel opening 2/ and is reported by the inventor-fisherman, to be selective for tanner crabs. While resembling those fished by the Japanese in the Bering Sea (Zahn, 1970) this pot is larger and heavier and is not fished with a groundline (Figure 6). A hinged base allows crabs to be dropped directly into vessel live tanks.

Processing and marketing problems are reflected in a comparison of value to the fishermen among Alaska's three commercial species of crabs. King crab and Dungeness crab presently bring approximately 60 percent and 33 percent greater price per pound respectively to the fishermen than do tanner crab. Processing and marketing problems have caused individual processors to maintain self-imposed "size limits" and "catch quotas" over the landings of their own fleets. While self-imposed, size limits presently act in lieu of a state regulation in protecting male breeding stocks, low processor catch quotas may be curtailing maximum utilization of the resource.

The Japanese fleet operating in the eastern Bering Sea utilizes strings of small pots attached to groundlines as well as tangle nets (Zahn, 1970). Prior to 1967-68, their catch had been, like ours, incidental to king crab. Japanese as well as Soviet factory ships now process tanner crab in increasing proportion to king crab in the eastern Bering Sea where they began operating about 1930 and 1959, respectively (Chitwood, 1969).

Tanner crab shell syndrome is apparently harmless to the meat within the crab, and is discarded at ecdysis along with the shell, gills and membranes which it affects. Infection is probably rapid once it begins, and the incidence may increase in the Marmot-Chiniak sub-area because of infected shells issuing from Kodiak City processor plants. It may cause early mortality in tanner crabs which have undergone their terminal molt because it has been observed to disable mouthparts and eyes. This may affect reproduction since female tanner crabs

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2/ Patent applied for by Mr. Charles S. Wells of Cordova, Alaska.

appear capable of reproducing for an unknown number of years following their terminal molt. The syndrome does not appear to be depth related. Areas adjacent to Shelikof Strait show by far the highest incidence and this fact should be considered when investigating cause and effect relationships.

Logbook Data

Logbook data for 1969 and 1970 indicate that crabs per pot were higher in the March-April period. This may be because the mating season occurs then (Brown and Powell, 1971) and males may migrate upward to depths more commonly fished (30-70 fathoms). Such a phenomenon is reported by Kato (1956) for male C. opilio in the Sea of Japan where there are protective fishing closures at that time of year. If increased fishing intensity causes the average size of crabs landed to drop notably, it may be necessary to consider such a closure in Alaska. However, present mean carapace widths indicate that unexploited stocks were still being cropped in early 1970 and that the average size of crabs landed had not been greatly reduced.

Logbook data indicate that fishing intensity is lowest and catch per pot highest at depths in excess of 100 fathoms. Although C. bairdi has been taken at depths of 259 fathoms (Garth, 1958), no fishing for that species is reported at depths greater than 140 fathoms in the Kodiak area. Most fishermen have considered it economically impractical to fish at depths greater than 100 fathoms.

Logbook data from depths in excess of 119 fathoms were lacking in 1970 because the data is all from the January through April period. Fishermen believe that the crabs are more abundant at shallower depths at that time of year.

Karinen discussed the vertical distribution and stock densities of tanner crab in the eastern Bering Sea (Haynes and Lehman, 1969) but this is totally undetermined in the Kodiak Area and Figure 12 shows only the depths at which commercial fishermen experienced the best catches per pot haul.

SUMMARY

I. Development of the fishery.

1. Tanner crab landings increased from less than 0.2 million pounds in 1967 to 14.5 million pounds landed during 1970, with the marked increase related to a decline in king crab abundance.

2. The Kodiak Area continues to lead in production, landing 61 percent

of the catch in 1969. The Eastside of Kodiak Island accounted for 43 percent of the area catch, followed by Marmot-Chiniak (19%), and the Westside (18%).

3. Marked production increases occurred in 1969, particularly in the Cook Inlet, Prince William Sound, and Bering Sea areas.

4. Tanner crab fishing gear generally consist of king crab pots converted for tanner crab fishing during closed king crab seasons. A new top entry pot has also been introduced.

5. Poor market conditions continue to be the chief deterrant to growth of the fishery and result from the following marketing and processing conditions:

   a. Uneconomical extraction of meat from the shell.

   b. Relatively low consumer acceptance.

   c. Competition on the U.S. market from imported Chionoecetes crab meat.

   d. A black growth on crab shells which causes difficulty during processing.

II. Logbook and size frequency data.

1. Logbook and size frequency programs were conducted during portions of 1969 and 1970 in the Kodiak Area. Differences in results between 1969 and 1970 were small and figures in 2 and 3 below are an average of the two years combined.

2. The statistics for the Eastside and Marmot-Chiniak sub-areas were similar to each other in terms of average number of crabs captured per pot (58 and 52 respectively), average size of crabs (158.7 and 157.6 mm carapace width, respectively) and average weight per crab (2.8 lbs. in both areas).

3. The westside sub-area was highest in average numbers of crabs per pot (95), lowest in average size of crabs (152.2 mm carapace width), and lowest in average weight per crab (2.6 lbs.).

ACKNOWLEDGMENTS

The author expresses grateful appreciation to Mr. Dexter Lall, Regional Research Supervisor, and others, for review of the manuscript, and to Mr. Norman V. Byrd for assistance in data collection.

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